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मात्राएँ और इकाइयाँ

भाग 6 प्रकाश तथा संबद्ध विद्युत-चुम्बकीय विकिरण

(पहला पुनरीक्षण)

Indian Standard

QUANTITIES AND UNITS

PART 6 LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS

(First Revision)

ICS 01.060; 07.030

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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NATIONAL FOREWORD

This Indian Standard (First Revision) which is identical with ISO 31-6 : 1992 'Quantities and units — Part 6 : Light and related electromagnetic radiations' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Basic Standards Sectional Committee and approval of the Management and Systems Division Council.

The text of the ISO Standard has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

Comma (,) has been used as a decimal marker while in Indian Standards the current practice is to use a point (.) as the decimal marker.

Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

In this revised version, the following are the major technical changes:

- the decision by the International Committee for Weights and Measures (Comité International des Poids et Mesures, CIPM) in 1980 concerning the status of supplementary units has been incorporated;
- the unit ångström, Å, in use temporarily, has been transferred to the "Conversion factors and remarks" column; and
- a number of new items have been added, e.g. photonic quantities and units.

In the adopted standard, normative references appear to ISO 31-8:1992, for which the corresponding Indian Standard is IS 1890 (Part 8) : 1995/ISO 31-8 : 1992 'Quantities and units — Part 8 : Physical chemistry and molecular physics (*first revision*) and is identical to ISO 31-8 : 1992.

ADDITIONAL INFORMATION

The other parts of IS 1890/ISO 31, under the general title 'Quantities and units' are:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 31-0 : 1992	IS 1890 (Part 0) : 1995 Quantities and units: Part 0 General principles (*first revision*)	Identical
ISO 31-1 : 1992	IS 1890 (Part 1) : 1995 Quantities and units: Part 1 Space and time (*third revision*)	Identical
ISO 31-2 : 1992	IS 1890 (Part 2) : 1995 Quantities and units: Part 2 Periodic and related phenomena (*second revision*)	Identical
ISO 31-3 : 1992	IS 1890 (Part 3) : 1995 Quantities and units: Part 3 Mechanics (*second revision*)	Identical
ISO 31-4 : 1992	IS 1890 (Part 4) : 1982/ ISO 31/4 : 1978 Quantities, units and symbols: Part 4 Heat (*first revision*) (*under revision*)	Technically Equivalent
ISO 31-5 : 1992	IS 1890 (Part 5) : 1995 Quantities and units: Part 5 Electricity and magnetism (*first revision*)	Identical

(*Continued on third cover page*)

Indian Standard
QUANTITIES AND UNITS
PART 6 LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS
(First Revision)

1 Scope

This part of ISO 31 gives names and symbols for quantities and units of light and related electromagnetic radiations. Where appropriate, conversion factors are also given.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 31. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 31 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 31-8:1992, *Quantities and units — Part 8: Physical chemistry and molecular physics.*

3 Names and symbols

The names and symbols for quantities and units of light and related electromagnetic radiations are given on the following pages.

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS

Quantities

Item No.	Quantity	Symbol	Definition	Remarks
6-1	frequency	f, ν	Number of cycles divided by time	
6-2	angular frequency	ω	$\omega = 2\pi\nu$	
6-3	wavelength	λ	Distance in the direction of propagation of a periodic wave between two successive points where at a given time the phase is the same	The wavelength in a medium is equal to the wavelength in vacuum divided by the refractive index of the medium (see 6-44).
6-4	repentency, wavenumber	σ	$\sigma = 1/\lambda$	In molecular spectroscopy $\tilde{\nu}$ is used for ν/c. The vector quantities $\boldsymbol{\sigma}$ and $\boldsymbol{k}$ corresponding to repetency and angular repetency are called wave vector and propagation vector respectively.
6-5 *(6-4.2)*	angular repetency, angular wavenumber	k	$k = 2\pi\sigma$	
6-6 *(6-5.1)*	velocity (speed) of electromagnetic waves in vacuum	c, c_0		c = 299 792 458 m/s (exactly) When it is necessary to make a distinction between phase velocity in a medium and phase velocity in vacuum, c is used for the former and c_0 for the latter.
6-7 *(6-6.1)*	radiant energy	Q, W, (U, Q_e)	Energy emitted, transferred or received as radiation	

Units

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS

Item No.	Name of unit	International symbol for unit	Definition	Conversion factors and remarks
6-1.a	hertz	Hz	1 Hz = 1 s^{-1}	
6-2.a	radian per second	rad/s		
6.2.b	reciprocal second, second to the power minus one	s^{-1}		
6-3.a	metre	m		ångström (Å), 1 Å = 10^{-10} m
6-4.a	reciprocal metre, metre to the power minus one	m^{-1}		The multiple cm^{-1} $\left(= 100\ m^{-1}\right)$ is often used.
6-5.a	radian per metre	rad/m		
6-5.b	reciprocal metre, metre to the power minus one	m^{-1}		
6-6.a	metre per second	m/s		
6-7.a	joule	J	1 J = 1 N · m	

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*continued*) Quantities

Item No.	Quantity	Symbol	Definition	Remarks
6-8 (*6-7.1*)	radiant energy density	w, (u)	Radiant energy in an element of volume, divided by that element	For non-polarized black-body (full) radiation $w_\lambda = 8\pi hc \cdot f(\lambda, T)$ and $w = \frac{4\sigma}{c} T^4$. The Planck constant h is equal to $h = (6{,}626\ 075\ 5 \pm 0{,}000\ 004\ 0) \times 10^{-34}$ J · s [1]. For $f(\lambda, T)$, see 6-19 and 6-20, and for σ, see 6-18. $w = \int w_\lambda \, \mathrm{d}\lambda$ See also the introduction, subclause 0.5.1.
6-9 (*6-8.1*)	spectral concentration of radiant energy density (in terms of wavelength), spectral radiant energy density (in terms of wavelength)	w_λ	Radiant energy density in an infinitesimal wavelength interval, divided by the range of that interval	
6-10 (*6-9.1*)	radiant power, radiant energy flux	P, Φ, (Φ_e)	Power emitted, transferred or received as radiation	$\Phi = \int \Phi_\lambda \, \mathrm{d}\lambda$
6-11 (—)	radiant energy fluence	Ψ	At a given point in space, the radiant energy incident on a small sphere divided by the cross-sectional area of that sphere	
6-12 (*6-10.1*)	radiant energy fluence rate	φ, ψ	$\varphi = \frac{\mathrm{d}\Psi}{\mathrm{d}t}$	$\varphi = \int \varphi_\lambda \, \mathrm{d}\lambda$ In an isotropic homogeneous radiation field, φ/c is the energy density, and the irradiance of a surface is $\varphi/4$
6-13 (*6-11.1*)	radiant intensity	I, (I_e)	In a given direction from a source, the radiant energy flux leaving the source, or an element of the source, in an element of solid angle containing the given direction, divided by that element of solid angle	$I = \int I_\lambda \, \mathrm{d}\lambda$

[1] CODATA Bulletin 63 (1986).

Units

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*continued*)

Item No.	**Name of unit**	**International symbol for unit**	**Definition**	**Conversion factors and remarks**
6-8.a	joule per cubic metre	J/m^3		
6-9.a	joule per metre to the fourth power	J/m^4		
6-10.a	watt	W	1 W = 1 J/s	
6-11.a	joule per square metre	J/m^2		
6-12.a	watt per square metre	W/m^2		
6-13.a	watt per steradian	W/sr		For the steradian, see the introduction, subclause 0.3.2.

LIGHT AND RELATED
ELECTROMAGNETIC RADIATIONS (*continued*) Quantities

Item No.	Quantity	Symbol	Definition	Remarks
6-14 (*6-12.1*)	radiance	$L, (L_e)$	At a point on a surface and in a given direction, the radiant intensity of an element of the surface, divided by the area of the orthogonal projection of this element on a plane perpendicular to the given direction	$L = \int L_\lambda \, \mathrm{d}\lambda$ For non-polarized black-body (full) radiation $L_\lambda = \frac{c}{4\pi} w_\lambda = 2hc^2 \cdot f(\lambda, T)$ and $L = \frac{\sigma}{\pi} T^4$. For $f(\lambda, T)$, see 6-19 and 6-20, and for σ, see 6-18.
6-15 (*6-13.1*)	radiant exitance	$M, (M_e)$	At a point on a surface, the radiant energy flux leaving the element of the surface, divided by the area of that element	Formerly called radiant emittance. $M = \int M_\lambda \, \mathrm{d}\lambda$ For non-polarized black-body (full) radiation $M_\lambda = \frac{c}{4} w_\lambda = 2\pi hc^2 \cdot f(\lambda, T)$ and $M = \sigma \cdot T^4$. For $f(\lambda, T)$, see 6-19 and 6-20, and for σ, see 6-18.
6-16 (*6-14.1*)	irradiance	$E, (E_e)$	At a point on a surface, the radiant energy flux incident on an element of the surface, divided by the area of that element	$E = \int E_\lambda \, \mathrm{d}\lambda$
6-17 (—)	radiance exposure	$H, (H_e)$	$H = \int E \, \mathrm{d}t$	
6-18 (*6-15.1*)	Stefan-Boltzmann constant	σ	The constant σ in the expression for the radiant exitance of a full radiator (black body) at the thermodynamic temperature T. $M = \sigma \cdot T^4$	$\sigma = \frac{2\pi^5 k^4}{15h^3c^2} =$ $(5{,}670\,51 \pm 0{,}000\,19) \times 10^{-8}\ \mathrm{W}/(\mathrm{m}^2 \cdot \mathrm{K}^4)$[1] The Boltzmann constant k is equal to $k = (1{,}380\,658 \pm 0{,}000\,012) \times 10^{-23}\ \mathrm{J/K}$[1].

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[1] CODATA Bulletin 63 (1986).

Units

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*continued*)

Item No.	Name of unit	International symbol for unit	Definition	Conversion factors and remarks
6-14.a	watt per steradian square metre	$W/(sr \cdot m^2)$		
6-15.a	watt per square metre	W/m^2		
6-16.a	watt per square metre	W/m^2		
6-17.a	joule per square metre	J/m^2		
6-18.a	watt per square metre kelvin to the fourth power	$W/(m^2 \cdot K^4)$		

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*continued*)

Quantities

Item No.	Quantity	Symbol	Definition	Remarks
6-19 (*6-16.1*)	first radiation constant	c_1	The constant c_1 and c_2 in the expression for the spectral concentration of the radiant exitance of a full radiator (black body) at the thermodynamic temperature T. $M_\lambda = c_1 f(\lambda, T) = c_1 \dfrac{\lambda^{-5}}{\exp(c_2/\lambda T) - 1}$	$c_1 = 2\pi hc^2 = (3{,}741\ 774\ 9 \pm 0{,}000\ 002\ 2) \times 10^{-16}\ \mathrm{W \cdot m^2}$ 1) The name first radiation constant has also been used for the factors $8\pi hc$ and hc^2 in the corresponding expressions for w_λ and L_λ (see remarks on 6-9 and 6-14).
6-20 (*6-17.1*)	second radiation constant	c_2		$c_2 = \dfrac{hc}{k} = (1{,}438\ 769 \pm 0{,}000\ 012) \times 10^{-2}\ \mathrm{m \cdot K}$ 1)
6-21.1 (*6-18.1*)	emissivity	ε	Ratio of radiant exitance of a thermal radiator to that of a full radiator (black body) at the same temperature	
6-21.2 (*6-18.2*)	spectral emissivity, emissivity at a specified wavelength	$\varepsilon(\lambda)$	Ratio of spectral concentration of radiant exitance of a thermal radiator to that of a full radiator (black body) at the same temperature	The spectral emissivity is a function of wavelength; this is indicated by the symbol $\varepsilon(\lambda)$.
6-21.3 (*6-18.3*)	directional spectral emissivity	$\varepsilon(\lambda, \vartheta, \varphi)$	Ratio of spectral concentration of radiance in a given direction ϑ, φ, of a thermal radiator to that of a full radiator (black body) at the same temperature	
6-22 (—)	photon number	N_p, Q_p, Q	For monochromatic radiation of frequency ν, $N_p = \dfrac{W}{h\nu}$ where W is the radiant energy	
6-23 (—)	photon flux	Φ_p, Φ	$\Phi_p = \mathrm{d}N_p/\mathrm{d}t$	The photon flux Φ_p is related to the spectral concentration of radiant energy flux $\Phi_{e\lambda}$ by $\Phi_p = \int \Phi_{e\lambda} \dfrac{\lambda}{hc}\, \mathrm{d}\lambda$ See 6-10.

1) CODATA Bulletin 63 (1986).

Units — LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*continued*)

Item No.	Name of unit	International symbol for unit	Definition	Conversion factors and remarks
6-19.a	watt square metre	$W \cdot m^2$		
6-20.a	metre kelvin	$m \cdot K$		
6-21.a	one	1		See the introduction, subclause 0.3.2.
6-22.a	one	1		See the introduction, subclause 0.3.2.
6-23.a	reciprocal second, second to the power minus one	s^{-1}		

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*continued*)

Quantities

Item No.	Quantity	Symbol	Definition	Remarks
6-24 (—)	photon intensity	I_p, I	In a given direction from a source, the photon flux leaving the source, or an element of the source, in an element of solid angle containing the given direction, divided by that element of solid angle	
6-25 (—)	photon luminance, photon radiance	L_p, L	At a point on a surface and in a given direction, the photon intensity of an element of the surface, divided by the area of the orthogonal projection of this element on a plane perpendicular to the given direction	
6-26 (—)	photon exitance	M_p, M	At a point on a surface, the photon flux leaving an element of the surface, divided by the area of that element	
6-27 (—)	photon irradiance	E_p, E	At a point on a surface, the photon flux incident on an element of the surface, divided by the area of that element	
6-28 (—)	photon exposure	H_p, H	$H_\mathrm{p} = \int E_\mathrm{p}\, \mathrm{d}t$	
6-29 (*6-19.1*)	luminous intensity	$I, (I_\mathrm{v})$		Luminous intensity is one of the base quantities on which the SI is based. See also 6-30. $I = \int I_\lambda\, \mathrm{d}\lambda$

Units

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*continued*)

Item No.	Name of unit	International symbol for unit	Definition	Conversion factors and remarks
6-24.a	reciprocal second per steradian	s^{-1}/sr		
6-25.a	reciprocal second per steradian square metre	$s^{-1}/(sr \cdot m^2)$		
6-26.a	reciprocal second per square metre	s^{-1}/m^2		
6-27.a	reciprocal second per square metre	s^{-1}/m^2		
6-28.a	reciprocal square metre	m^{-2}		
6-29.a	candela	cd	The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian	

LIGHT AND RELATED
ELECTROMAGNETIC RADIATIONS (*continued*) Quantities

Item No.	Quantity	Symbol	Definition	Remarks
6-30 (*6-20.1*)	luminous flux	Φ, (Φ_v)	The luminous flux $d\Phi$ of a source of luminous intensity I in an element of solid angle $d\Omega$ is given by $d\Phi = I \, d\Omega$	$\Phi = \int \Phi_\lambda \, d\lambda$ The luminous flux Φ is related to the spectral concentration of radiant energy flux $\Phi_{e\lambda}$ by $\Phi = \int K(\lambda) \, \Phi_{e\lambda} \, d\lambda$ where $K(\lambda)$ is the luminous efficacy (see 6-36.1 and 6-37.2).
6-31 (*6-21.1*)	quantity of light	Q, (Q_v)	Time integral of luminous flux	$Q = \int Q_\lambda \, d\lambda$
6-32 (*6-22.1*)	luminance	L, (L_v)	At a point on a surface and in a given direction, the luminous intensity of an element of the surface, divided by the area of the orthogonal projection of this element on a plane perpendicular to the given direction	$L = \int L_\lambda \, d\lambda$
6-33 (*6-23.1*)	luminous exitance	M, (M_v)	At a point on a surface, the luminous flux leaving an element of the surface, divided by the area of that element	Formerly called luminous emittance. $M = \int M_\lambda \, d\lambda$
6-34 (*6-24.1*)	illuminance	E, (E_v)	At a point on a surface, the luminous flux incident on an element of the surface, divided by the area of that element	$E = \int E_\lambda \, d\lambda$
6-35 (*6-25.1*)	light exposure	H	$H = \int E \, dt$	Formerly called quantity of illumination

Units

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*continued*)

Item No.	Name of unit	International symbol for unit	Definition	Conversion factors and remarks
6-30.a	lumen	lm	1 lm = 1 cd · sr	
6-31.a	lumen second	lm · s		
6-31.b	lumen hour	lm · h		1 lm · h = 3 600 lm · s (exactly)
6-32.a	candela per square metre	cd/m^2		
6-33.a	lumen per square metre	lm/m^2		
6-34.a	lux	lx	1 lx = 1 lm/m^2	
6-35.a	lux second	lx · s		
6-35.b	lux hour	lx · h		1 lx · h = 3 600 lx · s (exactly)

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*continued*) Quantities

Item No.	Quantity	Symbol	Definition	Remarks
6-36.1 (*6-26.1*)	luminous efficacy	K	$K = \frac{\Phi_v}{\Phi_e}$	$K = \frac{\int \Phi_{v\lambda}\, d\lambda}{\int \Phi_{e\lambda}\, d\lambda} = \frac{\int K(\lambda)\, \Phi_{e\lambda}\, d\lambda}{\int \Phi_{e\lambda}\, d\lambda}$
6-36.2 (*6-26.2*)	spectral luminous efficacy, luminous efficacy at a specified wavelength	$K(\lambda)$	$K(\lambda) = \frac{\Phi_{v\lambda}}{\Phi_{e\lambda}}$	For the notation $K(\lambda)$, see remark on 6-21.
6-36.3 (*6-26.3*)	maximum spectral luminous efficacy	K_m	The maximum value of $K(\lambda)$	For monochromatic radiation of frequency 540 × 10^{12} Hz, the spectral luminous efficacy is equal to 683 lm/W.
6-37.1 (*6-27.1*)	luminous efficiency	V	$V = \frac{K}{K_m}$	$V = \frac{\int V(\lambda)\, \Phi_{e\lambda}\, d\lambda}{\int \Phi_{e\lambda}\, d\lambda}$
6-37.2 (*6-27.2*)	spectral luminous efficiency, luminous efficiency at a specified wavelength	$V(\lambda)$	$V(\lambda) = \frac{K(\lambda)}{K_m}$	For the notation $V(\lambda)$, see remark to 6-21. $\Phi_v = \int K(\lambda)\, \Phi_{e\lambda}\, d\lambda =$ $K_m \cdot \int V(\lambda)\, \Phi_{e\lambda}\, d\lambda$ Standard values of $V(\lambda)$ relating to the light-adapted eye were adopted by the International Commission on Illumination (Commission internationale de l'éclairage, CIE) in 1971 and approved by the CIPM in 1972 [see Procès-verbaux du CIPM 40 (1972) 29, 145].
6-38 (*6-28.1*)	CIE colorimetric functions	$\bar{x}(\lambda)$, $\bar{y}(\lambda)$, $\bar{z}(\lambda)$	Trichromatic components, in the "CIE 1931 standard colorimetric system (XYZ)", of monochromatic light stimuli of equal energy. These functions are applicable to fields of observation of angular opening from 1° to 4°. For this standard colorimetric system $\bar{y}(\lambda) \overset{\text{def}}{=} V(\lambda)$.	In 1964 the CIE adopted another standard colorimetric system with colorimetric functions $\bar{x}_{10}(\lambda)$, $\bar{y}_{10}(\lambda)$, $\bar{z}_{10}(\lambda)$ applicable to fields of observations with angles greater than 4°.

Units

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*continued*)

Item No.	Name of unit	International symbol for unit	Definition	Conversion factors and remarks
6-36.a	lumen per watt	lm/W		
6-37.a	one	1		See the introduction, subclause 0.3.2.
6-38.a	one	1		See the introduction, subclause 0.3.2.

LIGHT AND RELATED
ELECTROMAGNETIC RADIATIONS (*continued*) Quantities

Item No.	Quantity	Symbol	Definition	Remarks
6-39 (*6-29.1*)	trichromatic coordinates	x, y, z	For the relative spectral energy or power distribution $\varphi(\lambda)$ $x = \frac{\int \varphi(\lambda)\bar{x}(\lambda)\ d\lambda}{\int \varphi(\lambda)\bar{x}(\lambda)\ d\lambda + \int \varphi(\lambda)\bar{y}(\lambda)\ d\lambda + \int \varphi(\lambda)\bar{z}(\lambda)\ d\lambda}$ and similar expressions for y and z. For light sources, $\varphi(\lambda) = \Phi_{e\lambda}(\lambda)/\Phi_{e\lambda}(\lambda_0)$ (relative spectral radiant energy flux). For object colours $\varphi(\lambda)$ is given by one of the three products $\varphi(\lambda) = \frac{\Phi_{e\lambda}(\lambda)}{\Phi_{e\lambda}(\lambda_0)} \cdot \begin{cases} \varrho(\lambda) \\ \tau(\lambda) \\ \beta(\lambda) \end{cases}$	$\varphi(\lambda)$ is called the colour tristimulus function. λ_0 is a reference wavelength. In the CIE 1964 standard colorimetric system (X_{10}, Y_{10}, Z_{10}), the symbols for the trichromatic coordinates are x_{10}, y_{10}, z_{10}. This system is applicable to fields of observation with angles greater than 4°.
6-40.1 (*6-30.1*)	spectral absorption factor, spectral absorptance	$\alpha(\lambda)$	Ratio of the spectral concentration of radiant or luminous flux absorbed to that of the incident radiation	For the notation $\alpha(\lambda)$, etc., see remark on 6.21. The symbols α, ϱ, τ and β are used for weighted averages of $\alpha(\lambda)$, $\varrho(\lambda)$, $\tau(\lambda)$ and $\beta(\lambda)$ respectively; the adjective spectral is then dropped from the names. The weighting will be different for the radiant and luminous factors. See also the introduction, subclause 0.5.1.
6-40.2 (*6-30.2*)	spectral reflection factor, spectral reflectance	$\varrho(\lambda)$	Ratio of the spectral concentration of radiant or luminous flux reflected to that of the incident radiation	
6-40.3 (*6-30.3*)	spectral transmission factor, spectral transmittance	$\tau(\lambda)$	Ratio of the spectral concentration of radiant or luminous flux transmitted to that of the incident radiation	
6-40.4 (*6-30.4*)	spectral radiance factor	$\beta(\lambda)$	At a point on a surface and in a given direction, the ratio of the spectral concentration of radiance of a non-self-radiating body to that of a perfect diffuser under identical irradiation conditions	
6-41 (—)	optical density	$D(\lambda)$	$D(\lambda) = -\lg\left[\tau(\lambda)\right]$	

Units

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*continued*)

Item No.	Name of unit	International symbol for unit	Definition	Conversion factors and remarks
6-39.a	one	1		See the introduction, subclause 0.3.2.
6-40.a	one	1		See the introduction, subclause 0.3.2.
6-41.a	one	1		See the introduction, subclause 0.3.2.

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*concluded*)

Quantities

Item No.	Quantity	Symbol	Definition	Remarks
6-42.1 (*6-31.1*)	linear attenuation coefficient, linear extinction coefficient	μ, μ_l	Relative decrease in spectral concentration of the radiant or luminous flux of a collimated beam of electromagnetic radiation during traversal of infinitesimal layer of a medium, divided by the length traversed	μ/ϱ, where ϱ is the volumic mass of the medium, is called the mass attenuation coefficient.
6-42.2 (*6-31.2*)	linear absorption coefficient	a	The part of the linear attenuation coefficient that is due to absorption	a/ϱ, where ϱ is the volumic mass of the medium, is called the mass absorption coefficient.
6-43 (*6-32.1*)	molar absorption coefficient	$\varkappa$	$\varkappa = \frac{a}{c}$ where c is the volumic amount of substance	For volumic amount of substance, see ISO 31-8.
6-44 (*6-33.1*)	refractive index	n	For a non-absorbing medium, the ratio of the speed of electromagnetic radiation in vacuum to the phase speed of electromagnetic radiation of a specified frequency in the medium	
6-45.1 (—)	object distance	p		
6-45.2 (—)	image distance	p'		
6-45.3 (—)	focal distance	f	For a single thin lens, the distance from the centre of the lens to the focal point	If the focal distance on the image side differs from that on the object side, the symbol f' is used for the former.
6-46 (—)	vergence, lens power	$1/f'$		For a thin lens, the vergence equals $1/f$.

Units

LIGHT AND RELATED ELECTROMAGNETIC RADIATIONS (*concluded*)

Item No.	Name of unit	International symbol for unit	Definition	Conversion factors and remarks
6-42.a	reciprocal metre, metre to the power minus one	m^{-1}		
6-43.a	square metre per mole	m^2/mol		
6-44.a	one	1		See the introduction, subclause 0.3.2.
6-45.a	metre	m		
6-46.a	reciprocal metre, metre to the power minus one	m^{-1}		

(*Continued from second cover page*)

ISO 31-7 : 1992	IS 1890 (Part 7) : 1995 Quantities and units: Part 7 Acoustics (*first revision*)	Identical
ISO 31-9 : 1992	IS 1890 (Part 9) : 1995 Quantities and units: Part 9 Atomic and nuclear physics (*first revision*)	Identical
ISO 31-10 : 1992	IS 1890 (Part 10) : 1995 Quantities and units: Part 10 Nuclear reactions and ionizing radiations (*first revision*)	Identical
ISO 31-11 : 1992	IS 1890 (Part 11) : 1995 Quantities and units: Part 11 Mathematical signs and symbols for use in the physical sciences and technology (*second revision*)	Identical
ISO 31-12 : 1992	IS 1890 (Part 12) : 1995 Quantities and units: Part 12 Characteristic numbers (*first revision*)	Identical
ISO 31-13 : 1992	IS 1890 (Part 13) : 1997 Quantities and units: Part 13 Solid state physics (*first revision*)	Identical

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